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Teuta Cata
Northern Kentucky University

Ben Martz
Northern Kentucky University

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Comparing Mobile APPs Usability Characteristics for Designers and Users

Teuta Cata
Ben Martz
Northern Kentucky University
USA

ABSTRACT

As the mobile device market grows, so grows the commercial market and therefore the subsequent development of applications for this medium. As this rush to develop apps continues to grow, the search continues for what characteristics will help mobile apps be adopted and continued to be used. This exploratory study looks to see if there are differences between how users of mobile applications and developers of mobile applications perceive these characteristics. The results of our study identified areas of statistically significant differences on key design characteristics between mobile application designers with mobile applications users. More interestingly, a detailed analysis found that there is likely disagreement in the consensus by the two groups concerning the characteristics' priority. The implications of this disagreement are an important factor for the development of new mobile applications.

Keywords: Mobile, APP, commercial markets, usability

INTRODUCTION

The mobile device market has become a significant consumer market targeted by major corporations and entrepreneurs. Market research by IDC predicts a worldwide market of 79.6 billion downloads of apps for 2015 (Khalaf, 2014). A recent survey on mobile devices shows that 90% of American adults have a cell phone, while 58% of them own a smartphone and 42 % own a tablet computer (Pew Research Center, 2014). In 2013, there were over 800,000 mobile apps in the Apple Store ®, but only 80 of them produced more than one million in a year. App development companies are dominating the development of mobile apps as they command about 98% of the new applications marketed (Rubin, 2013). This availability and commercial desire to reach users through smartphones is directly associated with the higher number of mobile application developed by companies.

This line of thinking produces the following questions: Is there a difference between how users and designers perceive a mobile app? Is there a difference between what causes you to acquire, to use, and to continue to use an application? One would suspect that users are more focused on the utility and productivity side while designers may focus on the technical side of the applications creation. Also, one could envision differences in what would cause a designer and what would cause a user to change or discontinue usage of an app. We see from the growth numbers, that the higher potential for growth resides with the user perspective. Therefore the focus of this study is to investigate differences between users and designers that may occur as mobile applications in are envisioned, designed, and coded.

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The research paper provides a short literature review discussing the generic differences found between users and designers. An exploratory survey is designed and implemented across two subject groups; one from a representative user environment and the second from a representative designer environment. The methodology used to collect data and organize the findings is discussed. Finally, conclusions drawn from the data are used to provide insight to the questions raised originally.

Designers versus users' perceptions on products

One of the biggest questions in designing a successful business product of any sort is to find and encode value into it. Drucker (1985) offers a classic discussion of quality [value] as perceived by suppliers and by customers. His base position is that customers pay for what gives them value and company's search to understand value with respect to the targeted users, not just the designers. The determination of a product's value comes from the user.

A similar example can be found in communication theory, where the sender-receiver model sets up the discussion around the meaning of a message. The meaning, in this case the value, would only exist if the message engages the receiver and is found to be effective by the receiver (Mosaic, 2014). Continuing the analogy for our application development purposes, the model sets up the discussion around comparing the designer's intent, the sender, and the user's realization, the receiver, when valuing a mobile application. These premises do not change as we move to the world of developing mobile applications.

The design of a successful mobile application has many moving parts and much research has been undertaken to look for key characteristics that may impact successful design and acceptance. Historically, areas studied include; the mobile context paradox, user interfaces, program designers and users perspectives, and social issues of culture and age. At a time when most consumers use the mobile apps no longer than 3 weeks after they first download them, raises the concern of what features a mobile app should have in order to increase mobile application stickiness. Investigating the way how a consumer interacts with the mobile apps and the desired features on those apps is extremely important in order to improve the online loyalty of mobile apps downloaded on consumers' smart devices (Furner, Racherla, & Babb, 2014).

The development of a software application, in one sense, is a negotiation between what the user wants and will use with what the designer understands the user wants. With the demand growth for access to data from a growing myriad of devices and entry points, developers are pushed to account for the complex environments.

In fact, Harrison et al (2013) point out the "mobile context" paradox that the user demands for mobile access to large amounts of data and information may work counter to keeping people mobile; restating, using a mobile app has the inherent requirement for the user to remain mobile. The searching features on mobile apps are ineffective mainly because the current presentation designs on mobile app do not support well the intensive scrolling that a user does while they perform a search using their mobile devices. The user's demand for more findings or data need a better virtualization and synchronous presentation of search engines on mobile devices.

Zhang and Adipat (2005) add several more new design issues created by the use of mobile apps in a mobile context including; connectivity, small screen size, varying display resolutions, limited processing capabilities, power, and data entry methods. In this same way of thinking, Adams (2006) lists information overload as a key design issue for mobile applications.

In the end, the mobile context has changed dramatically the issues involved in creating a workable and successful mobile application. The Inulkollu et al. (2014) discussion of mobile app development points heavily to the programming efficiency side of defining successful mobile app development. As Wasserman (2010) points out "One of the long-term challenges in every engineering discipline is finding appropriate techniques for managing increasingly complex projects."

User interfaces have long been an iterative process in the formal programming development field (Nielsen, 1993) and the user interface design has always been the intersection of user and programmer requirements. Design in this sense is more a user centered approach and the trend seems to move more toward "emotional, social, and cultural contexts" Boztepe (2007) where defining value is more complex. Similarly, Karapanos and Martens (2007) found that designers seem to give more weight to efficiency aspects of a design than users. In their study, users seemed to ascribe more weight to emotional aspects of using the products. For example, "easy to learn" – an effectiveness characteristic – was rated higher by designers while "privacy" – an emotional characteristic – was rated higher by users. Their conclusion was that designers may underestimate the importance of the emotional aspects of product use (p.209).

Dong and Lee (2008) looked for cross cultural differences in acceptance of webpages. Comparing three cultures – Chinese, Korean, and American, they found differences between patterns of viewing and searching webpages. Their study found differences and they used these to further defined characteristics preferred by analytically-minded and by holistically-minded people. Their conclusion was to offer design requirements based upon these competing perspectives and that successful design must incorporate both perspectives.

Finally, Gomes et al. (2014) discuss the development of a social networking interface for senior citizens. In their case study, they relate the development of a prototype Facebook interface based upon detailed focus groups and interviews. They compare their prototype against the standard Facebook interface. Using the Gomes et al. (2014) study in the context of our discussion here, one can envision the standard Facebook interface as designer oriented and the prototype as more "user defined."

For our study, we anticipate that there are differences between users of mobile applications and the designers of mobile applications. We have defined two sets of subjects: Users – those subjects surveyed in a user environment and; 2. Designers – those subjects surveyed in a design environment. Much like the research reviewed, we will look for differences between the two groups and seek to analyze those differences with respect to the creation of mobile applications for healthcare.

Usability of mobile applications

The rapid adoption rates of smartphones and the mobile applications have increased the interest of the information systems research on understanding the usefulness of such devices and applications from the consumers. There are several research streams that address the issue of mobile device usability.

One framework used on usability features is PACMAD - People At the Centre of Mobile Application Development (Harrison et al., 2013) which helps identify and organize the features of Nielsen's (1993) usability. The PACMAD model posits three factors that influence the overall usability: User, Task, and Context of Use. It drills down further and identifies seven features of Usability: Effectiveness, Efficiency, Satisfaction, Learnability, Memorability, Errors, and Cognitive Load. While the first three features (Effectiveness, Efficiency, and Satisfaction) have been recognized for applications in general, the authors point out that mobile applications environment – the mobile context mentioned above - has other features which should be considered. An interesting and complementary line of inquiry concerning mobile application development in healthcare is presented by Deng (2013) and Lin (2011). These studies combine combined the Technology Acceptance Model (TAM) with Health Belief Model (HBM) to investigate what perceptions drive consumers' behavioral intentions on using healthcare mobile applications. Both studies concluded that perceived usefulness, perceived ease of use, and external cues to actions, positively affect users' intention to use a healthcare application.

One meta-study conducted by Baharuddin et al. (2013) along with earlier detailed studies (Coursaris and Kim, 2011) identified effectiveness, efficiency, satisfaction, usefulness, and aesthetics as key usability characteristics of mobile apps. The usability characteristics are influenced by four contextual factors (Baharuddin et al., 2013). Table 1 details the contexts and some of the usability constructs used in our study as suggested by meta-analysis research.

Table 1: Contexts and Usability Constructs.

	Usability Characteristics					
Contextual Factors	Effectiveness	Efficiency	Satisfaction	…	Usefulness	Aesthetics
Users						
Environment						
Technology						
Task/Activity						

The research on usability characteristics has mainly been reported at a meta-analysis level, where usability characteristics were gathered and classified from the previous research published in information systems and other journals. A comprehensive study of usability features of mobile devices evaluated by participants in a survey is still missing. Furthermore, it seems likely that usability of a mobile application may be perceived differently between end users and the designers of such applications. Therefore our study endeavors to compare the end users' and designers' perceptions about usability of mobile applications and highlight any differences found between two groups.

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METHODOLOGY

This study used a survey to measure consumers' and designers' perception of usability of general mobile apps in their mobile devices. The framework proposed by Baharuddin et al. (2013) is used to construct the five contexts which include the usability features. Questions were developed for these five contexts using derivatives from previous research. For example, we used the top 10 usability dimensions from 9 other studies consolidated in the Baharuddin et al. (2013) study as the basis for our question concerning the most "important characteristics."
Following the broad framework, the survey questionnaire contains questions related to the following contexts:

- Users: The user's culture, age, experience with technology and mobile devices, perceptions, etc. will influence the way they user mobile devices and technology. The user context includes demographic questions (age, gender, education, background, race) and computer/mobile devices literacy and usage (years of owning the mobile devices, years of usage, how often do they use the devices per day, and if the devices are used for work or personal reasons).

- Technology: This area looks at how devices types, interfaces, the access to networks and other technology related factors will affect the way users access their mobile devices and the apps downloaded in them. Therefore, the technology context have questions related to devices and input modes consumers have, ability to buy new technology, memory of mobile devices, and being able to download mobile apps.

- Environmental context: The concern in this area is that physical location and environmental types and conditions will affect how users use their mobile devices and access the mobile apps in them. The items measuring this context address issues related to weather/ temperature conditions, being close to other people (familiar /unfamiliar), using GPS and pre-configured settings of mobile devices, and the preference to use voice or text based apps.

- Task/Activity Context: The items in the task context include questions related to the task on hand such as open or closed tasks, task difficulty, task duration, etc. Based on the task users want to perform in their mobile devices, the mobile apps may be usable or not. Some tasks may be predefined, simple, and closed ones, which increases the likelihood of using mobile apps. Other tasks that the user wants to accomplish may be difficult, complex, open, interactive tasks, and therefore the users may not be inclined to use his mobile device.

- Usability: The features of usability are measured in different ways. The survey has questions uses about usability features found in other research (effectiveness, satisfaction, efficiency, learnability, etc.) plus a few derived to help answer some new conjectures. We included ranking features question in order to get the perception of end user on which features are most important to them.

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As this was an exploratory study in nature, we took the opportunity to incorporate four new items of interest: Two sub contexts and two questions of inquiry. The two sub contexts are defined as Information and Adoption/Use. The genesis for the sub contexts can be found in previous usability studies, but with limited discussion:

- Information: This new context includes question related to information shared/accessed in a mobile app. We categorized and defined four characteristics that can be associated with information: personal, private, identifiable, and anonymous information. While some may consider this characteristic of information as a consequence of the Task context, we wished to look at it in more detail to see if it may command a more significant role than that of a subset of Task. Giving today's environment, it would be interesting to know if there are differences in the perception of information used or generated by a mobile app between those designing web applications and those using the web application. The questions below were used to tease out this question on four axes.

Figure 1: Example – Information Characteristics.

I consider the information I share over the app to be:	
Private – identifiable to me; however, no one should have other than who the app allows; it would change my life to have this exposed	SD 1 2 3 4 5 6 7 SA
Personal – identifiable to me; if someone found this it would be embarrassing, but no life altering.	SD 1 2 3 4 5 6 7 SA
Identifiable – someone could use it to figure out it was me	SD 1 2 3 4 5 6 7 SA
Anonymous – it cannot be tied to me	SD 1 2 3 4 5 6 7 SA

- Adoption/Use: This sub context is related to why consumers adopt and use a mobile app and can be seen as a derivative from the constructs found in the TAM model. The question in Adoption sub context presented assertions and rationale for first adopting an application: asking if mobile app is free, fun, recommended by peers, part of web access experience, or information driven. The question in the Use sub context gives four of the same scenarios but splits the information driven scenario into two; one driven by ease of use and the other driven by timeliness. The main purpose here is to first understand why a mobile app is adopted and then why it gets used. One area of research is in understanding adoption and usage characteristics between mobile apps that initiate the dialogue and those that have the dialogue initiated by the user.

-

Figure 2: Example - Adoption Questions.

I got this app because:	
My friend/business associate recommended it	SD 1 2 3 4 5 6 7 SA
It is part of a web access app I use (checking account; email)	SD 1 2 3 4 5 6 7 SA
It is free	SD 1 2 3 4 5 6 7 SA
It is fun	SD 1 2 3 4 5 6 7 SA
I wanted access to the information it provides	SD 1 2 3 4 5 6 7 SA

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Figure 3: Example – Use Questions.

I use the app a lot because:	
It lets me interact directly with my friends / business associate	SD 1 2 3 4 5 6 7 SA
It is part of a web access app I use (checking account; email)	SD 1 2 3 4 5 6 7 SA
It is free	SD 1 2 3 4 5 6 7 SA
It is fun	SD 1 2 3 4 5 6 7 SA
It provides the information I want easily	SD 1 2 3 4 5 6 7 SA
It provides the information I want timely	SD 1 2 3 4 5 6 7 SA

Referring back to Harrison et al (2013), we added a "mobile context" question. The conversation that is started may be started by the user of by the application. For example, an email notification or reminder is initiated by the application. Typing in a tweet is initiated by the user. The mobile context perspective would argue that there could be a difference in the initiation of mobile applications use. We tried to capture this directly with the question:

> When you access a mobile app, what percentage of the time did the app prompt you (versus you choosing to access it without prompting)?
>
> a. Less than 34%
> b. Between 34 and 65%
> c. More than 65%

The second additional question of inquiry relates to the healthcare perspective raised by Deng (2013) and Lin (2011) related earlier. One interesting analysis of mobile app usage published by Flurry Analytics is that while apps for sports, health and fitness are growing, 49% year-to-year, they are not growing at the same rate as productivity apps, a 149% rate (Khalaf, 2014). A more subtle interpretation of the Flurry findings is that to enjoy more likely growth, mobile apps should be designed as productivity enhancements first within the health and fitness market. The intersection of these observations, points to a potential killer-app opportunity in the health and fitness app market. The query becomes: Are there any differences mobile app users and mobile app designers that relate to the mobile healthcare market?

Participants in the study

The questionnaire was developed using the literature reviews mentioned earlier. Question type varied between; rank order, 7 pt rating, and simple multiple choice. The instructions were written and pretested with multiple other researchers acting as potential respondents. The edited and improved version of the questionnaire was used to collect data in this study. The questionnaire was placed online and in print format. Appendix A provides a subset of the survey showing the questions discussed later.

The data collection was conducted in two phases. In the first phase of data collection, we approached Facebook users to take the survey on mobile applications. One would think that a social network user, most likely will use mobile applications as well, and therefore presents an appropriate subject rich environment. Fifty participants took the survey and 48 of them shared demographic data. The profile of these participants – the users - is as follows:

Males were 35% of the participants, and Females were 65%. The age range varied from 18 years old to over 60 years old, where the dominant group is the 40 – 49 years age (21 participants). The demographic data on the education level shows that most participants had a graduate degree (41%) and a college degree (29%).

The second phase of data collection was conducted in a university setting. Potential subjects included both graduate and undergraduate students who were taking classes in information systems and mobile commerce. Conveniently, these students were also participating in a sanctioned, sponsored contest to develop mobile applications. The event required students to use their skills and expertise to create a prototype for mobile applications that the market needs. These students had an interest in designing and at the time of the survey were actually designing mobile apps. Again the environment – an event dedicated to developing mobile apps - seems a good environment to survey design oriented participants. At the end of the event, students were asked to take a survey around the usability of mobile applications. The profile of these participants – the designers - is as follows:

Forty seven students took the survey. The age range was between 20 years old to 59 years old (there were 2 students in the age group of 50 – 59 years old), where the dominant group was 21-29 years age (25 participants). The demographic data on education level shows that participants were attending a graduate program (21 participants), were attending college (15 participants), or had a graduate degree (9 participants).

FINDINGS

The groups did not differ on gender, education level, nationality, computer experience, or smartphone experience. The groups did differ on the demographic characteristic of Age with the designer group reporting a significantly lower age bracket than the users group. This can be expected as the population of the designer group was sampled was in a university environment. However, this is the only demographic characteristic that was significant different between two groups.

Healthcare versus non healthcare

The most popular mobile app category for both groups (calculated with 3 points for first place; 2 points for second place; and 1 point for third place mentions) was communication (117 pts – users and 76 - designers); followed by entertainment (45 pts – users and 26- designers). The third place position differed; for users it was Lifestyle Information (24 pts) and for designers it was Financial Banking (23 pts). The healthcare category was not popular for either group. The only healthcare app category that both groups used was the Fitness apps subcategory (users – 20 pts and designers 8 pts) (Table 2). For our purposes, it is noteworthy that the Pharmacy category and Healthcare Medical category which included refills, medication alerts, disease management, medical information, and first aid/emergency scored as the lowest two categories. This raw data parallels the IDC survey reviewed in the introduction that points to low visibility of healthcare applications usage in the high growth mobile application arena.

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Table 2: Most Frequent Mobile Apps Used (User vs. Designer).

Groups	Mobile Apps used by Participants (Q1)			
	1st Most Frequent	2nd Most Frequent	3rd Most Frequent	Healthcare apps
Users (Facebook)	Communication (117 pts)	Entertainment (45 pts)	Lifestyle Information (24 pts)	Fitness (20 pts)
Designers (students)	Communication (76 pts)	Entertainment (26 pts)	Financial banking (23 pts)	Fitness (8 pts)

Recognizing that healthcare apps may not be in the top mobile apps mentioned by respondents', another question was phrased more generally, and asked respondents for the adoption of any related categories (Healthcare Fitness, Healthcare Medical, and Pharmacy). As ~35% (17/48) of users and ~ 30% (14/47) of designers responded that they did NOT have a healthcare app in these categories, we can say that approximately 65% (users) and 70% (designers) of the respondents did have a general healthcare app. Within the categories established, Healthcare Fitness had the most acknowledged responses, followed by Pharmacy, and then Healthcare medical.

The data was divided into two groups based upon the respondent having a healthcare application or not. The respondents reporting having at least one healthcare app were compared to those reporting having no healthcare apps. An investigation of the data shows no significant statistical difference in the perception of usability characteristics between the two groups. This implies that design and usability characteristics of healthcare apps are not different from those of general apps, therefore designers should feel comfortable designing general healthcare apps in a way similar to general apps. However, we suggest that the implication does not extend to the use of mobile apps in healthcare application for patient care.

Designers verses users

No difference was found between users and designers in the initiation of the mobile application usage. The results in Table 3 below showed no significant difference. The results do show that the initiation of mobile app usage for both users and designers is done by the human user in general. This means that our suspected "mobile context" difference is not supported.

Table 3: Application as Initiator.

	Users	Designers
Less than 34%	29 (58%)	25 (56%)
Between 34 and 65%	15 (30%)	17 (38%)
More than 65%	6 (12%)	3 (7%)
Total	50	45

The inspection of the data with regard to Adoption and Use of mobile applications (Table 4) yields a little more interesting results. The "information" characteristic dominates the other characteristics in both adoption and use. From a practical standpoint, the access to information is the best selling point for adoption and use of mobile apps. The desire for the information provided by the app is the highest rated items in both question sets. Of note also, is that timely information

is rated higher than "ease of access" to information. This result points to the possibility of "timeliness of information" as a factor just as important as "ease of use" in users continuing to value and use of a mobile application.

Table 4: Adoption and Use Comparison.

Adoption	User	Designer	Sign. (1)
I got this app because:			
My friend/business associate recommended it	4.340	4.217	.899
It is part of a web access app I use (checking account; email)	4.840	5.511	.022
It is free	6.260	6.370	.291
It is fun	5.440	5.739	.113
I wanted access to the information it provides	6.100	6.413	.403
Use			
I use the app a lot because:			
It lets me interact directly with my friends / business associate	5.680	5.543	.924
It is part of a web access app I use (checking account; email)	5.200	5.717	.093
It is free	5.820	5.891	.384
It is fun	5.510	5.933	.122
It provides the information I want easily	6.240	6.565	.016
It provides the information I want timely	6.220	6.587	.002
(1) Mann-Whitney per Siegel (1956)			

Table 5 shows those areas throughout the whole survey where a significantly statistical difference in the groups can be observed. We used the Mann-Whitney, non-parametric test as suggested by Siegal (1956) to compare the two group's (users versus designers) perception on the mobile apps that they most *frequently use*. The test shows no difference relating to how the two groups perceive the usability characteristics (all rated positively) on the mobile apps they use concerning; Learnability, Effectiveness, Simplicity, Intuitiveness, Understandable, Attractiveness, and Satisfaction. However, the designer group ranked three characteristics significantly higher: Efficiency (p=0.033), Usefulness (p=0.007) and Aesthetic (p=0.006).

When the question was reframed to ask participants to answer why they *continue to use* a mobile app after they downloaded it, some things changed. The differences in Efficiency, Usefulness and Aesthetics, while still positive and designers rating them higher than users, lost their statistical significance. The differences in two other characteristics rose to a statistical significant difference. This analysis shows that designers appreciate the Satisfaction (p= 0.02) and Attractiveness (p=0.037) characteristic more than users when framed this way. There is no significant difference between the two groups on other usability characteristics in this *continue to use* framing.

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Table 5: Survey Questions with Significant Difference by Group (User vs. Designer).

Context / Question	Designer		User		Sign.(2)
	Rank	Mean Rank	Mean Rank	Rank	
Efficiency - The apps help me perform the task in a quick, effective, and economical manner.	8	54.51	42.97	3	.033
Usefulness - The apps are useful	4	55.79	41.79	7	.007
Aesthetic - The apps I use are aesthetic. I like their appeal.	3	55.86	40.62	11	.006
Satisfaction - Overall, I am satisfied with my mobile apps and am not looking to replace them	9	54.29	42.09	5	.020
Attractiveness - The apps are pleasing, charming, and attractive.	10	52.75	41.37	9	.037
I will not use voice-based apps around unfamiliar people	12	37.42	55.60	1	.001
I consider the information I share over the app to be: Anonymous – it cannot be tied to me	1	59.22	36.03	12	.000
I use the app a lot because: It provides the information I want easily	6	54.87	42.64	4	.016
I use the app a lot because: It provides the information I want timely	2	56.57	41.08	10	.002
I use the app a lot because: It is part of a web access app I use (checking account; email)	7	54.60	42.06	6	.022
I admit it, I do get anxious when my apps are "down"	11	42.46	54.06	2	.038
How many hours do you use a Mobile Device per day: (1)	5	54.96	41.47	8	.011
(1) Question used 4 categories and not the 7 point ordinal scale used by all other questions. (2) Mann-Whitney test prescribed by Siegel (1956)					

DISCUSSION

Our excursion looking for direct differences in users and designers of healthcare applications did not produce significant results. It did give some insight in that the general findings concerning mobile application usability and design relate to and are appropriate for the healthcare industry also.

We can now use Table 5 to better view the perception of the characteristics of the mobile apps between users and designers. The results show that designers seem to have more intense feelings than users about several key characteristics in relation to mobile apps. This seems rationale as the designers will on average have a greater commitment to mobile apps if they are developers of mobile apps. Designers are more willing to use the mobile apps for services that offer both website and mobile app access, than the users do. This implies a higher comfort level with technology that what users do. Designers perceive the information obtained by the mobile applications easier and timely compared to the users. That may be the reason why they got the mobile application in the first place. Designers value the ease of use and immediacy of the information higher than users.

The more critical observation is that the designer mean ranks were higher, showing a higher level of agreement with the question, than the user mean ranks, except for two. These two, one concerning the use of voice based apps around unfamiliar people and the other concerning the level of anxiety caused by not having access to a mobile app should be discussed. In the first case, the users significantly reject the use of voice based apps. The significance lies not only in the statistical difference, but also in the observation that this item was the highest ranked user response and the lowest ranked designer response pair across the survey. This finding would seem to have strong implications for the development of new voice based apps as it may portend a skeptical market.

These findings match with what Karapanos and Martens (2007) when they suggest that, users are more "emotional" when they use a product and are more concerned to privacy than designers are. Mobile applications users don't like the voice based mobile apps. They perceive the information private, and they don't like unfamiliar people around them to hear the information provided by the voice of the mobile app.

The second question concerning the perceived anxiousness of not having access to a popular app is the second highest item in the list for users but the second lowest ranked item for designers. The experience and comfort level with knowing what is going on in an app may make lead the designer less to be less anxious. This finding however leads to a more nuanced analysis of the perceived agreement between user and designer produces an issue for further study - priorities.

When the results of the user and designer ratings from Table 5 are put in rank order, a potential dissonance between the two groups is exposed. When computed using Excel's function CORREL, the two rank ordered lists have a negative correlation of (-0.804). This strong negative correlation implies that the priorities given these characteristics by users and designers may not be the same. So while there is agreement on the set of characteristics, there may not be consensus in the priority placed on these characteristics. This difference would become extremely important and obvious as resources are allocated and time frames narrow in the software development process. This would not show up directly in the research study data we collected, but does present a call for very interesting follow on studies for this research stream.

To summarize, the results of our study identified 12 areas of statistically significant differences on key design characteristics between mobile application designers with mobile applications users. In ten of the 12 designers showed to be more intense about their support for mobile apps. Their ratings dominated those of users on key characteristics such as usefulness, effectiveness, and satisfaction depending on the frame of adopting a mobile app or continuing to use a mobile app. However, a more detailed analysis found that there could be, and is likely, disagreement in the consensus by the two groups concerning the characteristics' priority.

Limitations of the study

This study has several limitations. A limitation of the current study is the small sample. Due to the method used on data collection, using Facebook to take the survey and participants in a mobile development contest, the study was under-powered and biased towards middle aged, very educated population. The small size, convenience, and homogeneity of the sample limits the generalizability of the study. Another limitation of the study was that the survey questions were partly taken from the research framework used, and partly adapted from literature review.

CONCLUSIONS

This comparison study between the designers and users of mobile applications shows no significant difference in four key areas: the most frequent mobile apps the participants use; the way how they initiate the interaction with those apps; the four contexts suggested by the literature review: Users, Technology, Environment, and Task/ Activity; and the usability characteristics of the mobile healthcare apps versus general mobile apps. Such findings allow us to make the

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statement that end users and designers agree in many aspects of mobile app designs and usability characteristics. Mobile apps have been in usage for few years now, and there has been an impressive learning curve on how to design such mobile apps and how to use them for the tasks we need to accomplish.

At the same time, this study found that even if the Usability Characteristics of a mobile app may be perceived almost in the same way between users and designers, three areas; the Adoption, Use, and the Continuing to Use a mobile app characteristics are significantly different between the two groups. Users appreciate more factors such as "non-voice based apps", as well as mobile apps that are reliable and efficient. In contracts, designers perceive "ease of access", "timeliness of information", and "ease of use" as most important features during adopt and use a mobile app.
In the end, if mobile applications are to be successful commercially, they must be developed with users' needs in mind. This study identified an interesting difference between users and developers; the priority of certain mobile applications adoption and use characteristics is different. This difference may be exposed during the development process as designers need to design apps based on what the users' need, not what they think that is cool.

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APPENDIX

Survey on Mobile Applications (Text Version of Web-based Survey)

Many characteristics contribute to the acceptance and ongoing use of a mobile app. Magazines, product reviews, surveys, etc. have been undertaken and have shown the characteristic list below to be the more positively mentioned. With your own list of "most used" mobile apps in mind, which three characteristics would you consider most important for you?

Effectiveness	SD 1 2 3 4 5 6 7 SA
Efficiency	SD 1 2 3 4 5 6 7 SA
Satisfaction	SD 1 2 3 4 5 6 7 SA
Usefulness	SD 1 2 3 4 5 6 7 SA
Aesthetic	SD 1 2 3 4 5 6 7 SA
Learn ability	SD 1 2 3 4 5 6 7 SA
Simplicity	SD 1 2 3 4 5 6 7 SA
Intuitiveness	SD 1 2 3 4 5 6 7 SA
Understandable	SD 1 2 3 4 5 6 7 SA
Attractiveness	SD 1 2 3 4 5 6 7 SA

Now, please rate each characteristic on its importance to you in continuing to use a mobile app:

Effectiveness	SD 1 2 3 4 5 6 7 SA
Efficiency	SD 1 2 3 4 5 6 7 SA
Satisfaction	SD 1 2 3 4 5 6 7 SA
Usefulness	SD 1 2 3 4 5 6 7 SA
Aesthetic	SD 1 2 3 4 5 6 7 SA
Learn ability	SD 1 2 3 4 5 6 7 SA
Simplicity	SD 1 2 3 4 5 6 7 SA
Intuitiveness	SD 1 2 3 4 5 6 7 SA
Understandable	SD 1 2 3 4 5 6 7 SA
Attractiveness	SD 1 2 3 4 5 6 7 SA

This survey is interested in finding out why people adopt and use mobile applications. Please, take a moment and think about the mobile apps you use the most. As you focus on those apps you use most, please answer the following on a scale of 1 (Strongly Disagree) to 7 (Strongly Agree):

Usability	
I frequently use my Mobile Applications because:	
The apps are accurate. (EFFECTIVENESS)	SD 1 2 3 4 5 6 7 SA
The apps help me achieve a specific goal or activity in a particular environment. (EFFECTIVENESS)	SD 1 2 3 4 5 6 7 SA
The apps help me perform the task in a quick, effective, and economical manner. (EFFICIENCY)	SD 1 2 3 4 5 6 7 SA
The apps are useful (USEFULNESS)	SD 1 2 3 4 5 6 7 SA
The apps I use are aesthetic. I like their appeal. (AESTHETIC)	SD 1 2 3 4 5 6 7 SA
The apps were easy to learn to use very quickly. (LEARNABILITY)	SD 1 2 3 4 5 6 7 SA

The apps are simple without too much information needed from me each time. (SIMPLICITY)	SD 1 2 3 4 5 6 7 SA
The apps have an intuitive user interface. (INTUITIVENESS)	SD 1 2 3 4 5 6 7 SA
The apps are independent activities in their own rights without undue dependencies to other applications and systems. (UNDERSTANDABLE)	SD 1 2 3 4 5 6 7 SA
The apps are pleasing, charming, and attractive. (ATTRACTIVENESS)	SD 1 2 3 4 5 6 7 SA
Overall, I am satisfied with my mobile apps and am not looking to replace them (SATISFACTION)	SD 1 2 3 4 5 6 7 SA

Tasks/Activity Context:	
I frequently use my Mobile Applications because:	
The apps help me accomplish my information obtaining tasks such as enabling alerts, silent modes, checking the list of received calls or messages, etc. (CLOSED TASKS)	SD 1 2 3 4 5 6 7 SA
The apps help me accomplish some interactive tasks such as phone calls, chats, filling in forms, keeping notes on a mobile phone, etc. (OPEN TASKS)	SD 1 2 3 4 5 6 7 SA
The apps help me accomplish tasks which usually have several subtasks and need several iterations to complete. (COMPLEX TASKS)	SD 1 2 3 4 5 6 7 SA
The apps help me to accomplish detailed tasks which take time and concentration to be accomplished. (TASK DURABILITY)	SD 1 2 3 4 5 6 7 SA
The apps help me accomplish difficult tasks about which I have serious expectations. (TASK DIFICULTY)	SD 1 2 3 4 5 6 7 SA

Environmental Context:	
I use my Mobile Applications when:	
Overall, I prefer voice-based apps to text-based.	SD 1 2 3 4 5 6 7 SA
I will not use voice-based apps around unfamiliar people	SD 1 2 3 4 5 6 7 SA
I allow my apps to use GPS and my location for information.	SD 1 2 3 4 5 6 7 SA
I use pre-configured settings (password; account; etc.) to quicken access to information.	SD 1 2 3 4 5 6 7 SA
Temperature and weather conditions have very little impact on my app use.	SD 1 2 3 4 5 6 7 SA
My apps provide me with a level of personal security and safety.	SD 1 2 3 4 5 6 7 SA

Technology Context:	
I try to use my Mobile Applications when:	
I will buy new technology (memory; phone; etc.) to use a new app	SD 1 2 3 4 5 6 7 SA
I have made other purchase decisions (clothes; household appliances; etc.) based upon the ability to use my technology and apps with it.	SD 1 2 3 4 5 6 7 SA
My mobile device has enough memory to support the Mobile App.	SD 1 2 3 4 5 6 7 SA
I admit it, I do get anxious when my apps are "down"	SD 1 2 3 4 5 6 7 SA